



## FOUNDERS OF MARYLAND TECHNOLOGY COMPANIES

## COMMUNICATIONS EQUIPMENT

Prepared by the Johns Hopkins  
Institute for Policy Studies

January 2003

Maryland Technology  
Development Corporation

Maryland Department of Business  
and Economic Development

# Founders of Maryland Technology Companies: Communications Equipment

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Johns Hopkins Institute for Policy Studies

January 2003

**Maryland Department of Business and Economic Development  
Maryland Technology Development Corporation**

*Research Partners*

Maryland Industrial Development Association

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# Founders of Maryland Technology Companies: Communications Equipment

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The “family histories” of Maryland technology companies are intertwined stories of entrepreneurs, technologies, and corporate structure. This project has focused on the pathways taken by the people who founded the technology companies operating in Maryland today. But it has been of necessity a study of corporations that have grown and shrunk, restructured or moved away, merged or spunoff, and of successive generations of technology development in core fields like vaccines, genomics, and optics. The results will help the state refine its marketing to both companies and potential entrepreneurs and better understand and capitalize on its research institutions and other technology generators. The Milken Institute’s 2002 survey ranked Maryland 4th overall in its ratings of states best positioned to take advantage of opportunities for growth in the New Economy, based on high scores in educational attainment, R&D, and capital availability. It is clear from this study that these same strong fundamentals have been providing fertile soil for technology entrepreneurship for 25, 50, and sometimes 100 years.

Six sectors were examined: bioscience and biomedical instruments, information technology equipment and services, private research and development, energy/chemicals/materials, defense and aerospace, and high technology machinery and instruments. Each sector was characterized by different patterns of entrepreneurship.

## Why Maryland?

The researchers sought to answer why entrepreneurs started their companies in Maryland by combing databases, websites, news archives, and, when necessary, telephoning companies to determine what brought the founders to the state. The hypotheses they tested were:

- Entrepreneur was born here and either stayed or returned
- Entrepreneur came to Maryland for a job in another firm and left it to start own company
- Entrepreneur stayed in Maryland to start own company when employer left/closed/was acquired/laid off employees

- Entrepreneur came to Maryland for job in a federal laboratory
- Entrepreneur came to Maryland for a job in a university
- Entrepreneur came to Maryland to go to school
- “Serial” entrepreneur cashed out of previous start-up and started new company

## Communications Equipment Entrepreneurship in Maryland: Findings

In this report, “communications equipment” includes:

- SIC 3651 and SIC 3861 Audio/video/camera equipment: Includes selected electronic audio and video equipment establishments that produce audio and video equipment used for communications.

- SIC 3661 Telephone and telegraph apparatus:

Includes customer premises (terminal) equipment, which is privately owned equipment attached to the telecommunications network, such as: telephones, key systems, facsimile products, modems, voice processing equipment, and video communication equipment.

Also includes network equipment such as transmission systems (multiplexing equipment, which allows multiple signals to share the same transmission path; repeaters; and line conditioning equipment) and switches (central office switches; packet switches, which provide economical transmission of large volumes of data over wide geographic areas; mobile telephone switching offices, microwave switches, and data communication switches.)

- SIC 3663 Radio and television communications equipment:

Includes radio-based communications systems for the provision of cellular, paging, and personal communications services, consisting of mobile switches, which complete connections either between mobile users or between mobile users and the public switched-telephone network; transmission equipment, which consists of radio transmitters, receivers, and transceivers (modules containing both receiver and transmitter) as well as other base station equipment such as antennas and amplifiers; and subscriber equipment, such as mobile and portable handsets.

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- SIC 3669 Communications equipment, not elsewhere classified: This category is rapidly becoming a catch-all, as computer networking becomes telecommunications. Among other items, it includes computer networking (network interface cards, LAN routers, LAN hubs, and LAN switches) and Internet-related equipment, and data concentration equipment. Communications security devices are included in a separate chapter of the Maryland Technology Founders reports.

- SIC 367 Electronic components and accessories: Includes semiconductors; passive components (electronic capacitors, resistors, coils and transformers, and connectors); and electronic components not elsewhere classified. Printed circuit board manufacturers that are part of this category (SIC 3672) have not been included in this study.

Of the approximately 140 establishments that the Maryland Department of Labor, Licensing and Regulation includes in these categories, at least 80 were founded in the state or were brought to Maryland by their founders, and are still operating in Maryland. Information on the experiences of entrepreneurs who have started, built, and sold companies and seen them closed by the purchasers is also included in this report.

These industries have led the surge of high technology employment growth in Maryland in the second half of the 1990s, growing to almost five percent of high tech employment by 2000. Economic development fortunes of Howard County and, to a lesser extent, Anne Arundel County, where many optical equipment makers have settled, have soared and plummeted with the fiber-optic industry. Spending on communications equipment and facilities declined 13.8 percent from 2000 to 2001, according to the Telecommunications Industry Association's 2002 Telecommunications Market Review and Forecast.<sup>4</sup> TIA projects an additional 10.8 percent drop in 2002, stabilization in 2003, and a return to high single-digit and double-digit rates by 2004 and 2005. TIA Vice President Mary Bradshaw, who served as project director for the report, said in the press release that accompanied its release, "although last year brought challenges to communications companies, the industry fundamentals remain solid."

Maryland's experience seems to embody this confidence. In a vastly reduced venture capital market, telecommunications companies accounted for over a quarter of the second quarter 2002 venture investments in the state. The Optical Oracle (a subscription-based service from Light Reading) notes that the companies attracting funding are those that have the potential to leverage

the over-investment in optical facilities made by carriers in the past several years—next-generation routers, multi-service provisioning platforms, content switches, DWDM systems, and next-generation data switches.<sup>5</sup>

Maryland's communications equipment companies will, however, continue to face technology challenges as innovations reshape the market. Former Federal Communications Commission head Reed Hundt and his colleagues wrote in the latest McKinsey Quarterly (Hundt is now a senior adviser) about the potential of Wi-Fi (wireless fidelity, an alternative means of Internet access) to thoroughly disrupt the markets of mobile carriers, telephone equipment companies, and DSL/cable modem service providers.<sup>6</sup> The Wi-Fi Alliance, formed in 1999 to certify the interoperability of wireless Local Area Network products, has 193 members that include many of the largest computer, software, and communications technology companies in the world. The nonprofit alliance has already certified 522 products based on the IEEE 802.11 specification (the underlying technology standard for wireless fidelity).<sup>7</sup>

### **The number of communications equipment company start-ups in Maryland has increased dramatically in recent years.**

From one to three communications equipment companies per year were founded in Maryland throughout the 1960s, 1970s, and 1980s. During the 1990s, the pace accelerated:

|      |              |
|------|--------------|
| 1990 | 4 companies  |
| 1991 | 2 companies  |
| 1992 | 1 company    |
| 1993 | 1 company    |
| 1994 | 3 companies  |
| 1995 | 6 companies  |
| 1996 | 3 companies  |
| 1997 | 3 companies  |
| 1998 | 6 companies  |
| 1999 | 8 companies  |
| 2000 | 10 companies |
| 2001 | 1 company    |

The bursting of the fiber optic bubble has undoubtedly put a damper on start-up enthusiasm, but there is always a lag time between companies' actual founding and the appearance of press coverage, so it is not yet possible to guess what the trend of the current decade will be. Particularly at the highly technical

<sup>4</sup> Highlights at [www.tiaonline.org](http://www.tiaonline.org)

<sup>5</sup> "Optical Funding: Down but Not Out," Byte and Switch, The Storage Network Site, July 18, 2001, [www.byteandswitch.com](http://www.byteandswitch.com)

<sup>6</sup> Hundt, Reed E., S. Newman, and J.E. Richards, "Wi-Fi Goes to Washington," The McKinsey Quarterly, 2002, Number 4, <http://www.mckinsey-quarterly.com>

<sup>7</sup> <http://www.weca.net>

end of this field, start-up activity is often shrouded in secrecy. Nova Telecommunications, founded in 1997, received several rounds of financing before it became widely known that it was David Huber's post-Ciena start-up, now called Corvis. Early announcements of Corvis' bold building and hiring plans in 1998 were not accompanied by product announcements until April 1999. Reference to Daniel Simpkins' (formerly of SALIX) new start-up, Hillcrest Communications, a "developer of converged media applications," is so far to be found only on his bio.

**The majority of Maryland communications equipment companies are home-grown but not necessarily by natives. Out-of-state founders have also moved their companies to Maryland.**

Maryland-born founders are found primarily among the older companies. The state's growing reputation as a communications industry center is evidenced by the large number of recent company founders who were neither born in the Maryland nor went to school here, but chose to start their firms here.

Several companies were moved to Maryland by their founders after starting them elsewhere. They include:

- Acterna, the holding company that includes the Maryland-based former Telecommunications Techniques Corporation, moved its \$1.4 billion headquarters to Maryland from Burlington, Massachusetts in January 2002 and is now one of the 20 largest private employers in the state.
- Broadcast Sports, a maker of miniaturized cameras for racing, was originally founded in Australia and brought frequently to the United States by ABC Sports to work on races. Its founders initially moved it to Connecticut and then to Maryland.
- The headquarters of e-Tenna, a company founded to commercialize the DARPA-funded technology of Titan Corp's (CA) aerospace electronics division, was moved from California to be consolidated with its R&D operations in Laurel in July 2002.
- Microlog was established in 1977 as a subsidiary of Virginia-based Old Dominion Systems. As it became better known, its parent changed its name to Microlog and moved its headquarters to Maryland.

**Once again, immigrants have an important role in building this sector of Maryland's high technology economy.**

Unlike the bioscience sector, most of the foreign-born founders and co-founders of communications equipment companies did not come to the United States for university or federal laboratory assignments. A recent study by the Public Policy Institute of California<sup>8</sup> found that immigrant professionals in Silicon Valley not only brought entrepreneurial energy but also maintained extensive ties to their home countries that enhanced the globalization of the Valley economy. Their home-country contacts opened up business opportunities, access to technology, and networks. Several foreign-born Maryland entrepreneurs have also tapped venture capital funds based in their native countries. The experience of Hemant Kanakia, founder of Torrent Networking Technologies (now Ericsson IT Infrastructure) is instructive. The "old school tie" has power across global boundaries. A graduate of the prestigious Indian Institute of Technology (IIT) in Bombay, he tapped the extensive network of IIT alumni to provide seed money, refine his business plan, identify potential angel funders, get venture funding commitments, and build his management and engineering teams. Several start-ups with ties to Israel have been able to tap venture funds in that country as well as U.S.-based funds.

**Table COMM EQ-5. Home Countries of Maryland Comm Equipment Entrepreneurs**

| Home Country | # of Entrepreneurs |
|--------------|--------------------|
| Australia    | 1                  |
| Canada       | 1                  |
| China        | 1                  |
| Hong Kong    | 1                  |
| India        | 2                  |
| Iran         | 2                  |
| Ireland      | 1                  |
| Israel       | 3                  |
| Korea        | 1                  |
| Taiwan       | 1                  |
| Vietnam      | 1                  |

<sup>8</sup>Saxenian, AnnaLee, reported in The Mercury News April 18, 2002, [www.bayarea.com/mid/mercurynews/3093754.htm](http://www.bayarea.com/mid/mercurynews/3093754.htm)

## Entrepreneurial government jumpstarted the communications industry in Maryland.

Maryland's history in the communications equipment industry began with an act of entrepreneurship by the U.S. government, the call by President Kennedy in 1961 for an international satellite communications system and the passage by Congress in 1962 of the Communications Satellite Act. The legislation created the Communications Satellite Corp. (Comsat), which was incorporated as a publicly traded company in 1963. Comsat led the creation of INTELSAT, an international satellite organization of 143 members and signatories, and provided satellite services and digital networking services, products, and technology. After another act of Congress in 2000, Comsat was sold to Lockheed Martin Corporation.

Entrepreneurs who trace their roots directly to Comsat include:

- Andrew Werth, co-founder in 1971 of Digital Communications Corporation (DCC); in 1978, DCC merged with Microwave Associates to form M/A-COM, Inc., which was subsequently purchased by Hughes Aircraft Company and became Hughes Network Systems.

- Richard Meyers and a group of other managers of Comsat's RSI Division, who bought the division and formed ParaGea in 1998.

**Unlike the bioscience sector, almost all the entrepreneurs in the communications equipment sector had previous experience working in other corporations, not universities or federal laboratories.**

Entrepreneurs in the communications equipment sector came to their start-ups with substantial corporate experience, most of it in large companies. While it was not always clear where among the many locations of the multi-nationals the entrepreneurs had previously worked, only about half the companies have a substantial Maryland presence. All but three of the cases where multiple entrepreneurs worked for the same former employer are accounted for by groups of employees leaving to form a new company.

**Table COMM EQ-1. Previous Company Experience of Maryland Comm Equipment Founders**

| Company Where Founder was Previously Employed             | # of Founders |
|---|---------------|
| ACF (Navy contractor)                                     | 1             |
| Acterna   | 1             |
| Aircraft Armaments Inc. (MD - became AAI)                 | 1             |
| Alex. Brown (MD)  | 1             |
| AlliedSignal (MD)   | 1             |
| Ascend Communications                                     | 1             |
| AT&T Labs   | 1             |
| Bailey Instruments  | 1             |
| Bell Atlantic (MD)  | 1             |
| Bendix Radio (MD - became AlliedSignal Field Engineering) | 1             |
| Bowles Fluidics (MD)                                      | 1             |
| California Microwave (MD)                                 | 2             |
| Celcore   | 1             |
| Ciena (MD)  | 1             |
| Data General  | 2             |
| Data Labs (acquired by Yurie)                             | 1             |
| Digital Technics (MD - sold to L3 Communications)         | 2             |
| ECI   | 1             |
| Entrada Networks  | 1             |
| Ericsson (MD)   | 1             |
| Fairchild Space and Defense (MD - now Orbital Sciences)   | 1             |
| General Instrument  | 1             |
| GTE Telnet  | 3             |
| Gould Electronics (MD)                                    | 3             |
| Hewlett Packard   | 1             |
| Honeywell Technology Solutions                            | 1             |

**Table COMM EQ-1. Continued**

| <b>Company Where Founder was Previously Employed</b>                   | <b># of Founders</b> |
|--|----------------------|
| Hughes Network Systems (MD)  | 2                    |
| IBM  | 2                    |
| I-Tel  | 1                    |
| ITT Industries (formerly International Telephone and Telegraphy Corp.) | 1                    |
| Laser Comm   | 1                    |
| Metric Resources Co.   | 1                    |
| NARCO Aviation Products  | 1                    |
| NEC  | 1                    |
| Nortel Networks  | 1                    |
| NYNEX  | 1                    |
| OAQ (MD)   | 2                    |
| Ohmeda Medical (MD)  | 1                    |
| Optelecom (MD)   |                      |
| PCB Piezotronics   | 1                    |
| Philco   | 1                    |
| Polk Audio (MD)  | 1                    |
| Prince George's County government (MD)                                 | 1                    |
| RCA  | 1                    |
| Rockwell International Corp.   | 1                    |
| SALIX (MD - acquired by Tellabs)                                       | 4                    |
| Samsung  | 1                    |
| Scorpio Communications   | 2                    |
| System Planning Corp.  | 2                    |
| Telecommunications Techniques Corp. (MD - TTC, later Acterna)          | 3                    |
| Telespan Services  | 1                    |
| Telrad Manufacturing   | 1                    |
| Timeplex   | 1                    |
| Titan Aerospace  | 1                    |
| Torrent Networking Technologies (MD)                                   | 2                    |
| Versatron  | 1                    |
| York Technologies  | 1                    |

By contrast, only a few of the communications equipment entrepreneurs have emerged from the ranks of university faculty or graduate students.

**Table COMM EQ-2. University Employment of Maryland Comm Equipment Founders**

| <b>University Where Founder was Previously (or continues to be) Employed</b>          | <b>Company Name(s)</b>   | <b># of Founders</b> |
|---|--|----------------------|
| Johns Hopkins Applied Physics Laboratory  | Gould Fiber Optics Division Syntronics                           | 2                    |
| Kanagawa Academy of Science and Technology  | Little Optics  | 1                    |
| University of Maryland  | Blue Wave Semiconductors<br>Quantum Photonics<br>Zagros Networks | 3                    |
| University of Maryland Center for Optoelectronic Devices, Interconnects and Packaging | Quantum Photonics  | 1                    |

A number of the companies and their entrepreneurs have links to Maryland universities, however.

- Iphotonics co-founder Peter Nagy has business and mechanical engineering degrees from University of Maryland.
- K&L Microwave's MIPS project (Maryland Industrial Partnerships program) with a University of Maryland electrical engineer in 1996 resulted in a new microwave bandpass filter that helped the company broaden its market beyond defense agencies to telecommunications.
- Little Optics is working closely with UMCP's Laboratory for Physical Science (which has a partnership with the National Security Agency) and one of its co-founders, John Hryniewicz, is a graduate student at the UMCP Department of Computer Science and Electrical Engineering's Photonics Technology Center.
- LogicTree co-founder Masoud Loghmani received a bachelors degree with honors from the University of Maryland; the company is located in College Park.
- Polk Audio's founders Matthew Polk and George Klopfer met as undergraduates at Johns Hopkins University.
- SentiO Networks co-founder Frank Miller taught operating systems at UMBC after SALIX was acquired by Tellabs and before SentiO was launched.
- Torrent Networking (now Ericsson IP Infrastructure)

founder Hemant Kanakia rejected early venture capitalists' insistence that he launch his start-up on the West Coast because his wife had been offered a position in the Department of Sociology at the University of Maryland.

- Xenotran is a graduate of the University of Maryland's Technology Advancement Program incubator.
- Yurie Systems founder Jeong Kim received bachelor's and master's degrees from Johns Hopkins University and a Ph.D. from the University of Maryland. Following the sale of his firm to Lucent, he made contributions of \$1 million and \$5 million respectively to the two universities. He currently holds a joint appointment as Professor of Practice in the University of Maryland's Department of Materials Engineering and the Department of Electrical and Computer Engineering.

**Founders of communications equipment companies tend to have at least a college degree, from a wide range of colleges and universities across the country.**

As might be expected in this industry, the university degrees are almost all in electrical engineering, with a few advanced degrees in physics and several MBAs.

**TABLE COMM EQ-3. University Degrees of Comm Equipment Founders**

| Universities                   | Company Name<br>(when founded)  | Under<br>Grad | Masters<br>or prof'l | PhD |
|--------------------------------|---|---------------|----------------------|-----|
| American Univ                  | Projected Reality   |               | X*                   |     |
| Auburn U.                      | Communications Systems Technology Inc.<br>(now General Dynamics)  | X             |                      |     |
| Brigham Young Univ             | Ciena, Corvis   |               |                      | X   |
| Capital Univ (Ohio)            | Matrics   | X             |                      |     |
| Capitol College (MD)           | Reactel<br>ViaCast Networks   | X<br>X        |                      |     |
| Carnegie Mellon Univ           | Visual Networks   | X             |                      |     |
| Case Western Reserve Univ      | Photuris; Torrent Networking Technologies<br>(now Ericsson IP Infrastructure)                           |               | X                    |     |
| Chestnut Hill College          | Projected Reality   | X             |                      |     |
| Clemson Univ                   | Iphotonics (now Selectron)  | X             |                      |     |
| Columbia Univ                  | Chromatis Networks (later Lucent)<br>Digital Communications Corporation<br>(now Hughes Network Systems) | X             | X<br>X               | X   |
| Cornell Univ                   | Chromatis Networks (later Lucent)<br>SALIX (later Tellabs)  | X             | X<br>X               |     |
| Dartmouth Univ                 | Quantum Photonics   | X             | X                    |     |
| Duke Univ                      | YAFO Networks   | X             |                      |     |
| Drexel Institute of Technology | Patton Electronics  | X             |                      |     |
| Eastern Illinois Univ          | SOTAS   | X             |                      |     |

**Table COMM EQ-3. Continued**

| Universities                               | Company Name<br>(when founded)  | Under<br>Grad | Masters<br>or prof'l | PhD |
|--|---|---------------|----------------------|-----|
| Eastern Oregon State Univ                  | Ciena, Corvis   | X             |                      |     |
| Florida Atlantic Univ                      | Iphotonics (now Selectron)  | X             |                      |     |
| Franklin and Marshall Univ                 | Essex Corporation   | X             |                      |     |
| George Washington Univ                     | InHand Electronics  | X             | X                    |     |
| George Washington Univ<br>Law School       | Communications Systems Technology Inc.<br>Link Plus                           |               | X                    |     |
| Indian Institute of Technology             | Photuris; Torrent Networking Technologies<br>(now Ericsson IP Infrastructure) | X             |                      |     |
| Indiana Univ                               | Maxion Technologies   |               |                      | X   |
| Johns Hopkins Univ (MD)                    | Definitive Technology   | X             | X                    |     |
|  | Polk Audio  | XX            |                      |     |
|  | Megisto Systems   |               |                      |     |
|  | ViaCast Networks  | X             |                      |     |
|  | Yurie Systems   | X             |                      |     |
| Lehigh Univ                                | Visual Networks   | X             |                      |     |
| Loyola College (MD)                        | ReachNet  |               | X                    |     |
| Massachusetts Institute<br>of Technology   | Little Optics   | X             | X                    |     |
|  | Megisto Systems   |               |                      |     |
|  | Optelecom   | X             |                      |     |
|  | Optinel Systems   | X             |                      |     |
| McGill Univ                                | Broadsoft   | X             | X                    |     |
| Memphis State                              | Integral Systems  | X             |                      | X*  |
| Michigan State Univ                        | SOTAS   |               | X                    | X   |
| New York Institute of Technology           | PhoneBridge   | X             |                      |     |
| New York Univ                              | Visual Networks   |               | X                    |     |
| Polytechnic Univ of NY                     | Digital Communications Corporation<br>(now Hughes Network Systems)            | X             |                      |     |
| Princeton Univ                             | PhoneBridge   | X             | X*                   |     |
|  | Seneca Networks   |               |                      |     |
| Principia College                          | Woodwind Communications (now VINA)  | X             |                      |     |
| Purdue Univ                                | K&L Microwave   | X             | X                    |     |
|  | Link Plus   |               |                      |     |
| Rensselaer Polytechnic Institute           | Zagros Networks   | X             | X                    | X   |
| Rutgers Univ                               | Maxion Technologies   | X             |                      | X   |
|  | PhoneBridge   |               |                      |     |
| Salisbury State Univ (MD)                  | K&L Microwave   | X             |                      |     |
| Stanford Univ                              | Photuris; Torrent Networking Technologies<br>(now Ericsson IP Infrastructure) |               |                      | X   |
|  | ViaCast Networks  |               | X                    |     |
|  |   |               |                      |     |
| Stevens Institute of Technology            | Digital Communicaitons Corporation<br>(now Hughes Network Systems)            |               | X                    |     |
| SUNY Buffalo                               | 3e Technologies International   |               | X                    | X*  |
| Swarthmore                                 | YAFO Networks   | X             |                      |     |
| Syracuse Univ                              | e-Tenna   |               | X                    | X   |
| Tamkang Univ, Taiwan                       | 3e Technologies International   | X             |                      |     |
| Technion Israel Institute of<br>Technology | CeLight   | X             | X                    |     |
|  | Chromatis Networks (later Lucent)   | X             |                      |     |
| Technische Hochschule (GER)                | Weinschel Assoc.  | X             |                      | X   |

**Table COMM EQ-3. Continued**

| Universities                        | Company Name<br>(when founded)   | Under<br>Grad    | Masters<br>or prof'l | PhD                         |
|-------------------------------------|--|------------------|----------------------|-----------------------------|
| Tel Aviv Univ                       | Chromatis Networks (later Lucent)  | X                |                      |                             |
| Texas A&M                           | Codeon   |                  |                      | X                           |
| Tri-State University                | ISI Security   | X                |                      |                             |
| United States Naval Academy         | ReachNet   | X                |                      |                             |
| U of Birmingham (UK)                | Xenotran   | X                |                      | X                           |
| U of California, LA                 | Optelecom  |                  |                      | X                           |
| U of Cincinnati                     | Vark Audio   | X                |                      |                             |
| U of Colorado, Boulder              | Optinel Systems  |                  |                      | X                           |
| U of Columbia                       | Matrics  | X                |                      |                             |
| U of Delaware                       | Integral Systems   | X                |                      |                             |
| U of Kentucky                       | Digital Communications Corporation<br>(now Hughes Network Systems)   | X                |                      |                             |
| U of Madras (India)                 | Codeon   | X                |                      |                             |
| U of Manitoba (CAN)                 | CeLight  |                  |                      | X                           |
| U of Maryland                       | Integral Systems<br>Iphotonics (now Selectron)<br>LogicTree<br>Maxion Technologies<br>Megisto Systems<br>Quantum Photonics<br>Yurie Systems<br>Zagros Networks | X<br>X<br>X<br>X | X<br><br>X           | X*<br><br><br>X<br>X<br>XXX |
| U of Maryland, Baltimore County     | Little Optics  |                  |                      | X*                          |
| U of Missouri                       | ViaCast  | X                |                      |                             |
| U of Montreal                       | Quantum Photonics  | X                |                      |                             |
| U of Pennsylvania                   | Digital Communications Corporation<br>(now Hughes Network Systems)   |                  | X                    |                             |
| U of Pittsburgh                     | Essex Corporation<br>Maxion Technologies   |                  | X                    | X                           |
| U of Rochester                      | Optinel Systems<br>Quantum Photonics   |                  | X                    | X<br>X                      |
| U of South Florida                  | Paratek Microwave  | X                |                      | XX                          |
| U of Toronto (CAN)                  | Maxion Technologies  |                  |                      | X                           |
| U of Washington                     | e-Tenna  | X                |                      |                             |
| U of Waterloo (CAN)                 | Little Optics  |                  | X                    | X                           |
| Virginia Polytechnic Univ           | InHand Electronics   | X                |                      |                             |
| Weizmann Institute of Science (ISR) | YAFO Networks  |                  |                      | X                           |

\*denotes graduate work but no terminal degree

**More communications entrepreneurs have emerged from federal laboratories located in Maryland or in nearby Washington, D.C. than from universities, but not a large number.**

The majority of the new federal lab-originated companies have been started by former employees of defense laboratories in Maryland and the District of Columbia. The area is now the home

of the primary Army and Navy materials laboratories as well as the Department of Defense's electronic communications intelligence agency. The Naval Research Laboratory's Systems Directorate includes an optical sciences division. On the civilian side, NASA's abiding telemetry interests and NIST's materials and electronics laboratories also provide fertile ground for communications innovations.

**Table COMM EQ-4. Federal Laboratory Experience of Maryland Comm Equipment Founders**

| Federal Laboratory/Agency Where Founder was Previously Employed | # of Founders |
|---|---------------|
| Army Research Laboratory (2 start-ups, Maxion & Paratek)        | 9             |
| FBI (Martin Kaiser)   | 1             |
| NASA (ISI Security)   | 1             |
| NASA Goddard (TSI TelSys)                                       | 1             |
| National Bureau of Standards (now NIST–Weinschel Associates)    | 1             |
| Naval Research Laboratory (2 start-ups, Codeon & Optinel)       | 4             |
| Navy's Chief of Naval Operations (SOTAS)                        | 1             |
| NSA/DoD (2 start-ups, Matrics & Optelecom)                      | 4             |

**However, the federal government is an important customer that helped entrepreneurs launch many of the state's communications equipment companies, often without outside equity financing.**

One common path used by communications equipment entrepreneurs to grow their companies (most often without outside capital), has been to sell to the federal government. In 1972, Optelecom started by selling laser night vision to the Air Force, then quickly began supplying fiber systems that remotely controlled aircraft, robots, and underwater vehicles to all branches of the military. It now concentrates on traffic monitoring and security surveillance, particularly in air traffic control systems.

Other companies went on to expand into commercial telecommunications markets. Yurie Systems is a good example. Founder Jeong Kim, a former nuclear submarine officer in the U.S. Navy, developed asynchronous transfer mode (ATM) access equipment to speed military communications. At the beginning, over 90 percent of his sales were to the federal government through AT&T, with which Kim had an exclusive deal. Then Kim began selling directly to the commercial telecommunications carriers, saw sales skyrocket and earnings grow sixfold in one year, and was able to complete an IPO in 1997 debt-free and then sell the company for \$1 billion to Lucent in 1998.

While not quite so dramatic, other telecommunications equipment companies that began by (and are still) selling to the federal government include:

- 3e Technologies

- Acterna (formerly Telecommunications Technique Corp.)
- Airpax
- American Microwave Corporation
- Antenna Research Associates
- Blue Wave Semiconductors (2002 SBIR with BMD0)
- Broad Spectrum Optics (DoD Dual Use Science and Technology program)
- Communications Systems Technology, Inc. (Motorola, now General Dynamics)
- Digital Receiver Technology, Inc. (formerly Utica Systems, Inc.)
- Essex Corporation
- e-tenna (core wireless technology based on work of Titan Corp.'s engineers for DARPA)
- Filter Networks (a division of EMI Technologies)
- FiberPlex
- GeoPhone Company, LLC (SDIO funding)
- Gould Fiber Optics
- Hughes Network Systems
- InHand Electronics
- Integral Systems
- ISI Security
- K&L Microwave
- Link Plus Corporation (formerly AMAF Industries, ARPA contract for R&D on FM and FDM/FM signals)
- Maxion Technologies (continues close ties to DoD labs for work on semiconductor lasers)
- Microflip (SBIR award for adaptive technology for the disabled)
- Microlog Corporation (started doing government work as Old Dominion Systems)
- Mitron Systems (traffic monitoring sold to state and local governments)
- nsgdata.com
- Nurad Technologies
- Optelecom (first contract in 1972 was for Air Force laser night vision system)
- ParaGea (now TeleSystems International Corp.) former COMSAT engineers serve international satellite communications industry with VSATs
- Paratek Microwave (technology based on antenna work the founder did at Army Research Lab, licensed from Army)
- Quantum Photonics
- Rescue Phone (hostage negotiator communications sold to law enforcement agencies)
- SAC-TEC Micro Devices (military memory modules)
- Salix Technologies (bought by Tellabs and closed, first contract was with NRL)
- Sigtek (now Filtronic Sigtek, Inc.)
- Syntonics (spinoff of JHU APL develops oscillators used in spacecraft)

- TSI Telsys (founded by ex-Goddard employees, continue to serve satellite systems market)
- Xenotran
- Yurie Systems (now Lucent)

About half the telecommunications equipment companies known to be founded in Maryland are on this list.

### Venture capital has supported the expansion of communications equipment companies in Maryland.

Venture capital has paved another path taken by entrepreneurs in the communications equipment field. Venture capital has flowed generously to Maryland companies in this industry since the late 1990s. The most active venture capitalists have been local.

Following the spectacular success of CIENA's IPO in 1997 and strong buying by telecommunications carriers, venture capital began to flow to communications equipment companies. The most active in funding Maryland companies have been:

- Novak Biddle Venture Partners  
(Bethesda, MD) 6 companies
- Riggs Capital Partners  
(DC) a division of Riggs National Corporation 6 companies
- Boulder Ventures  
(now headquartered in Owings Mills, MD) 5 companies
- New Enterprise Associates  
(Baltimore, MD) 5 companies

- Optical Capital Group  
(Columbia, MD) 5 companies
- Columbia Capital  
(DC) 4 companies
- Davenport Capital Ventures  
(MA) 4 companies

The significant participation by New Enterprise Associates in this industry segment should be noted. While this Baltimore-based venture capital firm is one of the largest in the country (\$5 billion under management), it traditionally has not found large numbers of Maryland companies that fit its investment criteria. In 90 percent of the cases in which NEA backs a company, it leads or co-leads the investment group, bringing other investors to the table.

The Optical Capital Group (OCG) and a 60,000 square foot accelerator were established in 2000 by Ciena and Corvis founder David Huber and Steve Gilbert (Gilbert Global Equity Partners) with backing from New Enterprise Associates and other venture firms around the country. OCG focuses on companies that provide innovative products for the data, cable, and telephony communications infrastructure. Two Maryland firms, Optinel Systems and Quantum Photonics have already graduated from OCG's Columbia-based accelerator and are doing business in Howard County.

**Table COMM EQ-6. Venture Capital for Maryland Comm Equipment Companies**

| Maryland Company  | Venture Capital Investors   |
|---|---|
| Airpax  | Industrial Growth Partners (funded management buyout 1999)  |
| Broadsoft   | Bessemer Venture Partners, Columbia Capital Equity Partners, Charles River Ventures (Q2 99); Broadband Office, Comdisco Ventures, Crescendo Ventures (Q2 00); Grotech Capital Group (2002)  |
| CeLight   | Goldman Sachs, Concord Ventures (ISRAEL), Advanced Technology Ventures, Tamir Fishman Ventures, Vertex Management Israel (Q2 01)  |
| Chromatis Networks<br>(bought by Lucent and later closed) | Seed: Jerusalem Venture Partners (1997)<br>1st round: Crosspoint Venture Partners, CommVentures, Jerusalem Venture Partners, Lucent Venture Partners (Q1 98)<br>2nd round: Eucalyptus Ventures, Soros Private Equity Partners, Anschutz Family Investment Company, Chase Capital Partners, Hambrecht & Quist's Access Technology Partners (Q4 99) |
| Ciena   | Sevin Rosen Funds, Interwest Partners, Vanguard Venture Partners, Charles River Ventures, Weiss Peck and Greer  |
| CODEON  | New Enterprise Associates, Mustang Ventures, Optical Capital Group, Amerindo, Grosvenor Funds, Canadian Imperial Bank of Commerce, Kinetic Ventures, Banc of America Securities, Boulder Ventures, Deutsche Bank Alex. Brown  |
| Corvis Corporation  | Kleiner Perkins Caulfield & Byers (Q2 99); Arete Ventures, Cisco Systems, Citizens Capital Inc., Kleiner Perkins Caulfield & Byers, Kinetic Ventures, Meritech AG, New Enterprise Associates, Worldview Technology Partners (Q3 99); Integral Capital Partners, Meritech AG, Worldview Technology Partners (Q4 99)                                |

**Table COMM EQ-6. Continued**

| <b>Maryland Company</b>  | <b>Venture Capital Investors</b>   |
|--|--|
| Dorsál Networks  | David Huber, Optical Capital Group, Davenport Capital Ventures, The Grosvenor Funds, Newbury Ventures  |
| Essex Corporation  | Networking Ventures LLC, GEF Optical Investment Company LLC  |
| e-tenna Corporation  | Titan Corporation and Archery Capital  |
| IBiquity Digital Corp.   | Clear Channel Communications, Entercom Communications, Ford Motor Company, Grotech Capital Group, J.P.Morgan Partners (FKA Chase Capital Partners), New Venture Partners (FKA Lucent New Ventures Group), Pequot Capital Management, Riggs Capital Partners, Susquehanna Partners, Waller Sutton Media Partners, Whitney & Co  |
| Little Optics  | Matrix Partners (MA), Northbridge Venture Partners (MA)  |
| LogicTree  | The Halifax Group (DC)   |
| Maxion Technologies, Inc.  | eCentury Capital Partners (DC)   |
| Megisto Systems  | Bessemer Venture Partners, Columbia Capital, Grotech Capital Group, New Enterprise Associates, Norwest Venture Partners, Saturn Ventures Partners  |
| NavTrak  | BaseCamp Ventures; Seacap Ventures; Formation, Inc.  |
| Optinel Systems  | 1st: OCG Ventures, Novak Biddle Venture Partners<br>2nd: Court Square Ventures, Teknoinvest , Birchmere Ventures with SilverHaze Partners, Four Seasons Ventures, the Dinner Club, Isis Capital and original investors (12/02)   |
| Paratek Microwave  | Novak-Biddle Venture Partners (Q1 99); Novak Biddle Venture Partners (Q2 99); Novak Biddle Venture Partners (Q3 99); ABS Ventures Ltd. Partnerships, One Motorola Ventures, Novak Biddle Venture Partners, Women's Growth Capital Fund Q1 00); Morgenthaler Ventures, Novak Biddle, J.P. Morgan Chase & Co., Investor AB, Riggs Capital Partners (2/01)  |
| Quantum Photonics  | 1st round: Optical Capital Group, The Grosvenor Funds<br>2nd round: Boulder Ventures, Core Capital Partners, Davenport Capital Ventures, Draper Atlantic, EDB Investments, Intersouth Partners, Kinetic Ventures, Riggs Capital Partners   |
| SALIX (bought by Tellabs and later closed)                       | New Enterprise Associates, Grotech Capital Group   |
| SentitO Networks   | Mid-Atlantic Venture Funds, Technology Venture Partners, Kodiak Venture Partners, Core Capital Partners, Inflection Point Ventures   |
| Torrent Networking Technologies (now Ericsson IP Infrastructure) | 1st round: Columbia Capital LLC (Phil Herget, manager of this investment), Draper International and angels<br>2nd round led by The Sprout Group, INVESCO Private Capital, Bayview Investors  |
| USA Digital Radio (now IBiquity Digital Corp.)                   | 1st round: Chase Capital Partners, Gannett Company, Radio One, Inc.<br>2nd round: Allbritton New Media, Beasley Broadcast Group, Bonneville International, ComVentures, DB Capital Partners, Flatiron Partners, Grotech Capital Group, Harris Corporation, H&Q Venture Associates, J&W Seligman & Co., Regent Communications, Riggs Capital Partners, Saga Communications, TI Ventures, Waller-Sutton Media Partners, Whitney & Co, Williams, Jones & Associates |
| Visual Networks  | Early rounds: Behrman Capital (NY), Mid Atlantic Ventures Funds, Venrock Associates (NY)<br>3rd round: AT&T Ventures (Chevy Chase MD), Pilgrim Baxter & Associates (Wayne PA), Riggs Capital Partners (DC), Trident Capital (Palo Alto CA)   |
| Woodwind Communications Systems (now VINA)                       | 1st round: Boulder Ventures, Novak Biddle Venture Partners<br>2nd round: Alta Partners, SpaceVest, Sterling Venture Partners   |
| Yafo Networks  | Early: ADC Ventures, Valhalla Partners<br>3rd: US Venture Partners, Boulder Ventures, Mellon Ventures, New Enterprise Associates, Wheatley Partners, WorldCom Venture Fund   |
| Zagros Networks  | 1st round: Mohr Davidow Ventures, Novak Biddle Venture Partners<br>2nd round: Mohr, Davidow Ventures, Novak Biddle Venture Partners, Cadence Design Systems  |
| Zeus Wireless (now part of Young Design Inc.)                    | ComVentures, Crescendo, Dynafund   |

As in the bioscience sector, venture capitalists have played key roles in the formation of Maryland's communications equipment companies. Jon Bayless of Sevin Rosen, a Dallas venture capital firm, was sent the original business plan for Hydralite by a business colleague in 1993. He liked it but made several important changes. He matched the plan's author, David Huber, with Patrick Nettles, an experienced telecommunications manager, and suggested a new name for the company, Ciena. He was not able to convince the two founders to start the company in Texas, however; both of them preferred an East Coast location and the northerner and southerner compromised on Maryland. More recently, Frank Bonsal, co-founder of the venerable New Enterprise Associates of Baltimore, has co-founded Seneca Networks. His partners include Wenli Yu, an experienced telecommunications equipment company executive—Data Labs (first acquired by Yurie, then Lucent), Woodwind Communications, Acterna—and Thomas

Scholl, formerly of Hughes Network Systems and a co-founder of Tology Networks (now Texas Instruments). Scholl, now a venture partner at Novak Biddle, is also involved in the launch of Zagros Networks, where he is serving as interim President and CEO.

**Venture capitalists and entrepreneurs have reaped substantial rewards as promising Maryland communications equipment companies were acquired by large corporations.**

After the early optical companies rewarded their backers through successful IPOs, the next wave of companies was snapped up by large corporations before they went public. Most of these companies are still operating in Maryland.

**Table COMM EQ-7. Acquisitions of Maryland Comm Equipment Companies**

| Company name   | Founder(s)   | Year founded | Acquirer                                 | Paid                  | Acquisition date |
|--|--|--------------|--|-----------------------|------------------|
| Bitcom   | Mohammad Soleimani                                 | 1997         | Com21 (CA)                               | \$4m                  | 6/00             |
| Chromatis Networks   | Rafi Gidron and Orni Petruschka                    | 1998         | Lucent Technologies, Inc.                | \$4.8b                | 6/00             |
| Communications Systems Technology Inc. (Communications Solutions Division) | John S. Wilburn, Jr. Roger L. Danielson            | 1991         | Motorola, later General Dynamics         | not disclosed         | 3/00             |
| Digital Technics   | Fred Korangy                                       | 1989         | L3 Communications                        | n.a.                  | 1998             |
| Dorsál Networks  |  | 2000         | Corvis                                   | \$90m                 | 5/02             |
| Hekimian   | Norman Hekimian                                    | 1968         | Spirent PLC                              | \$1.6b                | 11/00            |
| Iphotonics   | Susan Trumble, Moez Adatia, Peter Nagy             | 1999         | Solectron                                | not disclosed         | 8/01             |
| K&L Microwave  | Richard Bernstein                                  | 1970         | Dover Corporation                        | n.a.                  | 1983             |
| ParaGea Communications LLC   | Richard Meyers and group of former COMSAT managers | 1998         | TeleSystems International (Gaithersburg) | not disclosed         | 8/02             |
| Salix Technologies   | Daniel Simpkins                                    | 1990         | Tellabs                                  | \$300m                | 12/99            |
| Sigtek   |  | 1990         | Filtronic plc                            | \$20m                 | 8/00             |
| SOTAS  | Peter L. Willson                                   | 1989         | Safeguard Scientifics (PA)               | Sold 80% to Safeguard | 6/99             |
| Torrent Networking Technologies  | Hemant Kanakia                                     | 1996         | Ericsson                                 | \$450m                | 4/99             |
| Woodwind Communications Systems  | Brian Hardy +                                      | 1995         | VINA Technologies (CA)                   | \$50 million          | 11/00            |
| Yurie Systems, Inc.  | Jeong Kim  | 1992         | Lucent Technologies, Inc.                | \$1b                  | 5/98             |

**Founders and employees of acquired companies often worked for the buying company for a short time, then went on to other entrepreneurial pursuits.**

Even when the acquiring companies closed the acquired Maryland communications equipment company (or moved its operations out of state), the entrepreneurs resurfaced in other Maryland companies. Cashed-out entrepreneurs who did not launch new companies have become venture capitalists in their own right and/or served as directors of new start-ups, in both cases providing mentoring to a new generation of entrepreneurs.

The career of one of the fathers of telecommunications in the region, John Puente, provides an illustrative example of serial entrepreneurship. With a team from COMSAT Laboratories, he co-founded Digital Communications Corporation (DCC) in 1971, and served as a director of M/A-COM, Inc., the company formed

in 1978 when DCC merged with Microwave Associates. M/A-COM was acquired by Hughes Aircraft Company and became Hughes Network Systems in 1987. Puente went on to found SouthernNet, Inc., a fiberoptic long distance carrier that was acquired by MCI; to co-found the National Telecommunications Network, a national consortium of long distance fiber optic communications companies; to serve as chairman of the board of Telogy Networks, a provider of embedded communications software to communications equipment manufacturers that was acquired by Texas Instruments in 1999; and to become CEO and later Chairman of the Executive Committee of Orion Network Systems, Inc.

Subsequent activities of Maryland communications equipment company founders are shown below.

**Table COMM EQ-8. Next Steps for Cashed-Out Maryland Comm Equipment Entrepreneurs**

| Company   | Founder   | Subsequent MD Activities   |
|---|---|--|
| Digital Communications Corp.                                    | John Puente<br>Andrew M. Werth<br><br>O. Gene Gabbard   | See text above<br><ul style="list-style-type: none"> <li>• Pres, Hughes Network Systems Intl</li> <li>• The Washington Advisory Group LLC</li> <li>• Co-founder, SouthernNet (acquired by MCI)</li> <li>• EVP &amp; CFO MCI</li> <li>• Special limited partner, Ballast Point Ventures</li> </ul>  |
| Digital Technics LP   | Fred Korangy  | <ul style="list-style-type: none"> <li>• Co-founder and Pres, LogicTree</li> </ul>   |
| K&L Microwave   | Richard Bernstein   | <ul style="list-style-type: none"> <li>• Pres &amp; CEO of EMI Technologies, owner of Filter Networks</li> <li>• Pres &amp; CEO of BAI Aerosystems and CEO of subsidiary Lorch Microwave</li> </ul>  |
| Optelecom (and collaborator on Hydralite, predecessor of Ciena) | William Culver  | <ul style="list-style-type: none"> <li>• Pres &amp; CEO, Comptic, Inc. (DC)</li> <li>• Industrial Physicist, Georgetown U. Department of Physics</li> </ul>  |
| ReachNET  | John C. Kirby, Jr.  | <ul style="list-style-type: none"> <li>• Managing Partner, Baltimore Venture Mentors</li> <li>• CIO, Quantum Solutions LLC</li> </ul>  |
| SALIX Technologies  | Daniel Simpkins<br><br>Officers: Terry Wolters, Frank Miller, William Flanagan, Mark Stubbe, Aaron Sipper | <ul style="list-style-type: none"> <li>• CEO Hillcrest Communications</li> <li>• Bd of Dir, Seneca Networks</li> <li>• Co-founders and officers of SentitO Networks</li> </ul>   |
| SOTAS, Inc.   | Peter L. Willson  | <ul style="list-style-type: none"> <li>• Continues as CTO and VCH of SOTAS</li> <li>• 1Exec Comm, Fund II, NextGen Capital LLC</li> </ul>  |
| Telogy Networks   | John Puente<br>Tom Scholl   | See text above<br><ul style="list-style-type: none"> <li>• COB Paratek Microwave</li> <li>• COB Seneca Networks</li> <li>• Bd member Woodward Communications</li> <li>• Strategic advisory bd, RIVIEN (formerly CI@rity Communications)</li> <li>• Interim Pres and CEO, Zagros Networks</li> <li>• Venture Partner, Novak Biddle</li> </ul> |
| Torrent Networking Technologies                                 | Hemant Kanakia<br><br>VPs: Gordon Saussy, Carol Politi  | <ul style="list-style-type: none"> <li>• Founder, Bd member Photuris, Inc. (MD)</li> <li>• Co-founder, CEO Gemplex Internet (VA)</li> <li>• Co-founder, Pres &amp; CEO, Megisto Systems</li> <li>• Co-founder, VP Mktg, Megisto Systems</li> </ul>   |
| Visual Networks   | Scott Stouffer, Robert Markovich, Robert Troutman   | <ul style="list-style-type: none"> <li>• Managing Directors, The Hatch Group (venture capital)</li> </ul>  |
| Woodwind  | Wenli Yu (was COB)  | <ul style="list-style-type: none"> <li>• Pres &amp; CEO, Seneca Networks</li> </ul>  |
| Yurie Systems   | Jeong Kim   | <ul style="list-style-type: none"> <li>• Professor of Practice, UMD Department of Materials Engineering</li> </ul>   |

## Communications Equipment Entrepreneurship in Maryland: Implications for Policy and Programs

The telecommunications industry is in a depression, the result of a combination of overall global economic weakness, what some perceive to be overinvestment in fiber infrastructure in anticipation of demand, and, ironically, the development of new technologies that allow carriers to increase the capacity of their existing infrastructure. Industry analysts believe that the sector generally lags economic cycles, slower to feel downturns but also slower to recover.<sup>9</sup> The Telecommunications Industry Association's 2002 Market Review and Forecast<sup>10</sup> calls for spending by carriers on fiber cable to begin growing again by 2004, on dense wavelength multiplexing to begin growing by 2003, and on optical switches to continue to enjoy positive growth through 2005.

*In anticipation of economic and sectoral recovery, we need to support Maryland's burgeoning communications equipment sector in its efforts to survive the downturn. State and county leaders in the private and public sectors need to take whatever steps necessary to understand the short-term needs of the industry and to provide help when asked.*

Companies in specialized niches within the industry are growing in spite of the overall downturn. Next generation routers and products that enable money-losing carriers to get more productivity out of existing infrastructure are continuing to attract venture capital, along with communications equipment companies that are not dependent on the fortunes of telecommunications carriers.

*Continuing to nurture young home-grown companies and capitalizing on the state's reputation as a center of innovation in the industry to attract new companies will help fill vacated space and employ laid-off workers. Some companies may in fact be attracted by the "bottom of the market" opportunity to pick up move-in space and a ready workforce.*

One of Maryland's key advantages for this sector is its workforce. Early entrepreneurs looked to the state as the home of skilled communications workers, both on the research and development side and in manufacturing.

*We need to preserve this pool of valuable workers, moving aggressively to help laid-off workers find employment in Maryland. Economic development officials in Howard County, which lost more than 1,000 fiber optics positions in 2001, have worked closely with downsizing employers to support out-placement of laid-off workers.*

With economic recovery, carriers should begin spending again, and Maryland innovators need to be ready. The seed corn for innovation is being sown now, in corporate, university, and federal laboratories.

*We need to redouble efforts to promote interaction among communications equipment researchers across all sectors, and to support collaborative research and development. When the state's own finances recover, strong consideration should be given to expanding the University of Maryland's Maryland Industrial Partnership program, the Department of Business and Economic Development's Challenge Investment program, and TEDCO's Federal Laboratory Partnership Program, Maryland Technology Transfer Fund, and University Technology Development Fund, which share the costs of very early R&D that companies believe has commercial potential.*

*We need to continue to fine-tune university policies and practice regarding the roles faculty may play in start-up companies, and the flexibility of the terms of their employment (leaves of absence, "start-up sabbaticals" etc.). A parallel look at the legal environment and individual lab policies in federal laboratories needs to be undertaken.*

16 <sup>9</sup>See for example, Robert Rosenberg, Susan Kalla, and Scott Anderson quoted in Bill Atkinson, "No Recovery on Horizon for Telecoms," The Sun, March 28, 2002, C1.

<sup>10</sup>Op.cit.

After the first stunning successes of Maryland communications equipment company IPOs, the primary exit vehicle for venture investors has been acquisition.

*Close attention should be paid to the mergers and acquisitions markets as well as the flows of venture capital to determine whether the virtually overnight financial success of the most promising companies in the 1990s will be repeatable, or whether traditional sources of financing will be needed to fuel more measured growth of this sector.*

The lead time afforded by this downturn may also give other jurisdictions an opportunity to prepare sites for the growth of the communications equipment industry that has been concentrated in Howard and Anne Arundel Counties.

*In particular, Baltimore City should evaluate the potential for assembled or existing cost-competitive sites on the southern side of the city within easy reach of the existing concentration of communications equipment firms, for example Montgomery Park and the Camden/Russell corridor.*

Purchases by the federal government have provided a foundation for the communications equipment sector in Maryland since its beginnings. The Department of Defense has traditionally been the largest buyer.

*Further investigation of federal procurement trends and opportunities in this sector should be undertaken and shared with Maryland's congressional delegation.*

Federal and international telecommunications policy can have a profound effect on the openness of markets to all vendors and to innovative technologies. The Telecommunications Industry Association supports globally open markets, promotion of compe-

tion among incumbents and new competitors, removal of subsidies from the cost structures of telecommunications services, refraining from regulating new broadband networks, and steady removal of existing regulations that are no longer necessary to encourage competition and/or protection of consumer interests.<sup>11</sup>

*Discussions with Maryland communications equipment companies about which of these issues and others are most important to them will help inform federal policymakers interested in supporting the growth of this industry in the state.*

While not as extensively international as the bioscience sector, many communications equipment entrepreneurs are foreign-born and have used networks of fellow expatriates and colleagues in their home countries to help launch and fund their companies.

*We need to fully exploit Maryland's international communications equipment networks to reach new companies and entrepreneurs around the world.*

Maryland's communications equipment companies have grown and flourished largely through the efforts of seasoned managers from large companies from across the country. Maryland's companies are beginning to supply a homegrown next generation of managers for new communications equipment firms, sometimes through a "serial entrepreneur" or through the recruitment of second-level managers in established firms to head new start-ups. This entrepreneurial talent pool is a corollary benefit of efforts by all in Maryland to help communications equipment companies grow significantly within the state.

*We need to continue and intensify efforts to support the growth of our strongest communications equipment companies as they adjust to technology advances and new market realities.*

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<sup>11</sup>[www.tiaonline.org/policy/broadband.cfm](http://www.tiaonline.org/policy/broadband.cfm)



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